AmerGen
An Exelon Company

Clinton Power Station
R. R. 3, Box 228
Clinton, IL 61727

10 CFR 50.73

U-603691

September 10, 2004

U. S. Nuclear Regulatory Commission
Document Control Desk
Washington, D. C. 20555-0001

Clinton Power Station, Unit 1
Facility Operating License No. NPF-62
NRC Docket No. 50-461

Subject: Licensee Event Report 2004-003-00

Enclosed is Licensee Event Report (LER) No. 2004-003-00: Main Power Transformer Protective Relaying System Design and Lightning Cause Scram. This report is being submitted in accordance with the requirements of 10CFR50.73.

Should you have any questions concerning this report, please contact Mr. William Iliff, Regulatory Assurance Manager, at (217)-937-2800.

Respectfully,

R Bement

R. S. Bement
Site Vice President
Clinton Power Station

RSF/blf

Enclosure: Licensee Event Report 2004-003-00

cc: Regional Administrator – NRC Region III
NRC Senior Resident Inspector – Clinton Power Station
Office of Nuclear Facility Safety – IEMA Division of Nuclear Safety

JE22

NRC FORM 366 (7-2001) U.S. NUCLEAR REGULATORY COMMISSION

APPROVED BY OMB NO. 3150-0104 EXPIRES 7-31-2004

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LICENSEE EVENT REPORT (LER)

(See reverse for required number of digits/characters for each block)

1. FACILITY NAME	2. DOCKET NUMBER	3. PAGE
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4. TITLE

Main Power Transformer Protective Relaying System Design and Lightning Cause Scram

5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED	
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER
									None	05000
07	13	2004	2004	– 003 –	00	09	10	04	FACILITY NAME: None	DOCKET NUMBER: 05000

9. OPERATING MODE	1
10. POWER LEVEL	095

11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check all that apply)

20.2201(b)	20.2203(a)(3)(ii)	50.73(a)(2)(ii)(B)	50.73(a)(2)(ix)(A)
20.2201(d)	20.2203(a)(4)	50.73(a)(2)(iii)	50.73(a)(2)(x)
20.2203(a)(1)	50.36(c)(1)(i)(A)	X 50.73(a)(2)(iv)(A)	73.71(a)(4)
20.2203(a)(2)(i)	50.36(c)(1)(ii)(A)	50.73(a)(2)(v)(A)	73.71(a)(5)
20.2203(a)(2)(ii)	50.36(c)(2)	50.73(a)(2)(v)(B)	OTHER Specify in Abstract below or in NRC Form 366A
20.2203(a)(2)(iii)	50.46(a)(3)(ii)	50.73(a)(2)(v)(C)	
20.2203(a)(2)(iv)	50.73(a)(2)(i)(A)	50.73(a)(2)(v)(D)	
20.2203(a)(2)(v)	50.73(a)(2)(i)(B)	50.73(a)(2)(vii)	
20.2203(a)(2)(vi)	50.73(a)(2)(i)(C)	50.73(a)(2)(viii)(A)	
20.2203(a)(3)(i)	50.73(a)(2)(ii)(A)	50.73(a)(2)(viii)(B)	

12. LICENSEE CONTACT FOR THIS LER

NAME	TELEPHONE NUMBER (Include Area Code)
G. A. Halverson, System Manager	(217) 937-3102

13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT

CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX

14. SUPPLEMENTAL REPORT EXPECTED			15. EXPECTED SUBMISSION DATE	MONTH	DAY	YEAR
	YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)

A suspected lightning strike to the A Phase of the 345 Kilovolt (kV) line 4.5 miles from the station resulted in a generator trip and automatic reactor scram. The Main Generator Trip System 2 received an instantaneous neutral phase over-current trip on the station ITH Relay. The ITH relay monitors the difference between the current in the Main Power Transformer (MPT) neutral legs and the sum of the 345 kV Main Power Output breakers phase currents; the purpose of this scheme is to provide protection for the high voltage leads for a ground fault. All control rods fully inserted. The cause of the event was a legacy design vulnerability that was unknown to the Station. The design of the protective relaying system and breaker trip logic for the MPTs had some weaknesses since current transformers in the circuit had potential saturation issues. The potential for current transformer saturation along with the speed of the ITH relay made the circuit vulnerable to false tripping. The magnitude of the fault, grid conditions (load and reactance) at the time of the fault, and the timing of the fault allowed the vulnerabilities to result in an unexpected reactor trip. The corrective action was a design change to replace the ITH relay with a relay that has a time delay in the tripping circuit to permit proper sequencing of the protective relaying during transmission line faults.

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

PLANT OPERATING CONDITIONS PRIOR TO THE EVENT

Unit: 1 Event Date: 7/13/2004 Event Time: 1608 Central Daylight Time

Mode: 1 (POWER OPERATION) Reactor Power: 95 percent

DESCRIPTION OF THE EVENT

On July 13, 2004, a Tornado Warning was in effect and the plant was in the off-normal procedure for Tornado / High Winds. At about 1608 hours, with the plant at 95 percent power, a fault occurred on the 345 Kilovolt (kV) line 4535 (Brokaw), causing 345 kV Gas Circuit Breakers (GCB) [BKR] 4502 and 4506 to open in the Switchyard [FK]. GCB 4502 and GCB 4506 are the Brokaw line circuit breakers to the Clinton Power Station (CPS) switchyard ring bus [BU]. GCB 4506 is also one of two main power output breakers; GCB 4510 is the other main power output breaker.

The Main Generator [GEN] [TB] Trip System 2 received an instantaneous neutral phase over-current trip on device 150-NT1, the station ITH relay [RLY]. The ITH relay is configured in a residual differential scheme. It monitors the difference between the phase current in the Main Power Transformer (MPT) [EL] [XFMR] neutral side legs and the corresponding sum of the 345 kV GCB 4506 & 345 kV GCB 4510 phase currents.

The fault occurred on Phase A of line 4535 approximately 4.5 miles from the Station. The fault current was approximately 10,000 Amps; about 5400 Amps of the 10,000 Amps fault current was supplied from the station Main Generator. The fault cleared in 2.5 cycles when GCB 4502 and GCB 4506 opened. The ITH relay is set to actuate at a 1600 Amp differential current between the MPTs and the 4506 / 4510 GCBs.

The design of the protective relaying system for the MPT has all Current Transformers (CT) [XCT] connected in parallel, feeding a single ITH relay coil. The ITH relay is an instantaneous over-current relay, single-phase type. The vulnerability of this design is that a fault of significant magnitude outside of the zone of protection producing a high DC offset can result in unequal saturation of the CTs. When unequal saturation occurs in the associated CTs, a differential current will flow in the ITH relay. Due to the speed of the ITH relay actuation the Generator Trip System 2 circuit lockout will actuate before the fault can be cleared and the normal current flow is restored. If the normal current had been restored (fault removed) prior to the actuation of the ITH relay, the false trip would not have occurred.

The over-current trip caused a Main Generator Trip System 2 Lockout actuation that tripped 345 kV GCBs 4506 and 4510 open and prevented GCB 4506 from re-closing which, during a normal response, would have re-closed following the clearing of the fault. The Generator trip caused a Main Turbine [TRB] [TA] trip and Turbine Control Valve [V] fast closure, resulting in an automatic reactor scram. All control rods fully inserted.

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

At 1609 hours, the B Reactor Recirc (RR) [AD] pump [P] downshifted to slow speed, while the A RR pump failed to transfer to slow speed and tripped off. In response to the pump tripping off, operators entered the Abnormal Reactor Coolant Flow off-normal procedure. Condition Report 235773 was initiated to investigate this issue and troubleshooting identified high contact resistance in two cell switches in the breaker close logic. The contacts were cleaned to correct this issue.

Immediately following the scram, as expected, reactor pressure vessel (RPV) water level dropped below the Low, Level 3 trip setpoint (Low, Level 3 is +8.9 inches Narrow Range indication), initiating the Reactor Protection System [JC]. As expected, the Low, Level 3 RPV water level trip caused Primary Containment Isolation Valves [ISV] in Group 2 (Residual Heat Removal (RHR)[BO]), Group 3 (RHR), and Group 20 (miscellaneous systems) to receive signals to shut; these valves were already shut prior to the event in accordance with the normal plant lineup. Operators entered the actions of the Reactor Scram Off-Normal procedure in response to the reactor scram and the lowering RPV water level and entered the Emergency Operating Procedure (EOP) for RPV Level Control due to the low reactor water level transient.

At 1709 hours, the reactor scram signal was reset.

At 1728 hours, operators exited the RPV Level Control EOP and transitioned into the Unit Shutdown procedure.

By 1800 hours, reactor coolant pressure was stable and being controlled between 600 and 650 psig using the Turbine Bypass Valves, and reactor coolant level was stable and being maintained between 30 and 39 inches narrow range using the Motor-Driven Reactor Feed Pump [MO] [P] [SJ].

At 2009, operators exited the reactor scram off-normal procedure and at 2012 exited the Abnormal Reactor Coolant Flow off-normal procedure.

The reactor remained in Mode 3 (HOT SHUTDOWN).

No Main Steam Isolation Valves closed and no Safety Relief Valves lifted during this event.

Condition Report 235764 was initiated to track the investigation and resolution of this event.

No automatic or manually initiated safety system actuations were necessary to place the plant in a safe and stable condition. No other inoperable equipment or components directly affected this event.

CAUSE OF THE EVENT

The root cause for this event is a legacy design vulnerability that was unknown to CPS. A review of the protective relaying system and breaker trip logic for the Main Power Transformers concluded that the design of the circuit was adequate for the application but had some weaknesses since the circuit had potential saturation issues with its current transformers. The potential for unequal current transformer saturation along with the speed of the ITH relay made the circuit vulnerable to false tripping. The protective relay scheme was the standard scheme used by the Switchyard owner at the time of station design.

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NARRATIVE *(If more space is required, use additional copies of NRC Form 366A)* (17)

A fault on the grid external to the station resulted in a reactor scram. Based on the atmospheric conditions at the time of the event, the most probable cause of the fault was a lightening strike to the A phase of the Brokaw line. The magnitude of the fault, grid conditions (load and reactance) at the time of the fault, and the timing of the fault allowed the vulnerabilities to result in an unexpected reactor trip.

SAFETY ANALYSIS
This event is reportable under the provisions of 10CFR50.71(a)(2)(iv)(A) due to the unplanned automatic actuation of the Reactor Protection System [JC].

There were no actual safety consequences associated with his event. The event was reviewed for analyzed transients discussed in Chapter 15 of the Clinton Power Station Updated Safety Analysis Report. The analysis determined that this event was within the design basis of the plant.

No safety system functional failures occurred during this event.

CORRECTIVE ACTIONS
An immediate corrective action was to enhance the existing protective scheme to include a brief time delay. The instantaneous over-current ITH relay has been replaced with a time over-current CO-2 type relay in accordance with Design Change Package EC 350247. It is expected that the design change adding the time delay to the tripping circuit will allow a similar fault condition to be cleared by the line relays with no unexpected reactor trip. The slightly slower actuation time for the time delay relay will allow transmission line faults to clear before a neutral differential over-current actuation due to unequal current transformer saturation.

PREVIOUS OCCURRENCES
None

COMPONENT FAILURE DATA
None